

WHAT IS CLAIMED IS:

1                   1.       A method of scheduling a media object for transmission between a  
2 server and a client, the method comprising:  
3                   partitioning the media object into segments of blocks, wherein each block is a  
4 unit of media for which the client will wait to receive an entire block before playing out the  
5 block, and wherein each segment includes an integer number of blocks;  
6                   determining one or more channels on which to serve each segment, the  
7 channels capable of carrying data between the server and the client;  
8                   determining a rate at which to serve each segment; and  
9                   determining a schedule pair for each channel, the schedule pair including a  
10 time at which the client may start receiving on the channel and a time at which the client may  
11 stop receiving on the channel.

1                   2.       The method of claim 1 wherein if the client minimally fulfills the  
2 schedule pair for each channel, the client will be able to play out the media object  
3 uninterrupted after a startup latency.

1                   3.       The method of claim 1 wherein the partitioning step includes first  
2 partitioning the media object into segments, then partitioning each segment into an integer  
3 number of blocks.

1                   4.       The method of claim 1 wherein the partitioning step includes first  
2 partitioning the media object into blocks, then grouping the blocks into segments.

1                   5.       The method of claim 1 wherein a maximum download rate at the client  
2 is less than an aggregate server transmission rate.

1                   6.       The method of claim 1 wherein a maximum download rate at the client  
2 is unconstrained.

1                   7.       The method of claim 1 wherein a maximum download rate at the client  
2 is only slightly greater than a media object play out rate.

1                   8.       The method of claim 1 wherein a maximum download rate at the client  
2 is less than a media object play out rate.



1                   22.     The method of claim 2 wherein the client can minimally fulfill the  
2     schedule pair for each channel by downloading from a maximum number of concurrent  
3     channels.

1                   23.     The method of claim 1 wherein the number of channels is less than or  
2     equal to a maximum number of concurrent channels served by the server.

1                   24.     The method of claim 1 wherein the partitioning, determining one or  
2     more channels, determining a rate, and determining a schedule pair steps are performed so as  
3     to optimize a server bandwidth required to serve the media object.

1                   25.     The method of claim 1 wherein the partitioning, determining one or  
2     more channels, determining a rate, and determining a schedule pair steps are performed so  
3     that the media object is served to the client at a rate less than or equal to a maximum client  
4     download rate.

1                   26.     The method of claim 1 further comprising, for each of the plurality of  
2     segments, determining a size of the segment so that the segment is completely downloaded  
3     by the client prior to when the segment is due to be played out.

1                   27.     The method of claim 26 wherein, for each of the plurality of segments,  
2     the rate at which to serve the segment is an integer multiple of a base rate.

1                   28.     The method of claim 26 wherein all of the segments are served at a  
2     same rate.

1                   29.     The method of claim 1 further comprising, for each of a plurality of  
2     segments:  
3                   if the segment may be scheduled to be served to the client without exceeding a  
4     maximum client download rate, scheduling the segment to be served to the client; and  
5                   if the segment may not be scheduled to be served to the client without  
6     exceeding the maximum client download rate, waiting to schedule the segment to be served  
7     until one or more other segments are scheduled to end being downloaded at the client.









order in which to encode the blocks; and wherein the block encoder is configured to generate, in the order, output symbols for each block; and

a transmitter coupled to receive the output symbols from the block encoder, and coupled to receive, for each segment, an indication of one or more channels on which to serve the segment and a rate at which to serve the segment;

said transmitter configured to serve the output symbols on the corresponding one or more channels at the corresponding rate.

69. A method of receiving a media object that includes segments of blocks, wherein each segment includes an integer number of blocks, and wherein each block is a unit of media for which a client will wait to receive an entire block before playing out the block, the method comprising:

receiving a media object description of the media object;  
joining and leaving each of a plurality of channels according to the media object description to download the segments;  
reassembling the blocks in each segment; and  
playing the blocks out in an order after a startup latency.

70. The method of claim 69 wherein a client joins channels according to an order in the media object description.

71. The method of claim 69 wherein, reassembling the blocks of a first segment and playing out the blocks of a second segment occur concurrently.

72. The method of claim 69 wherein segments are downloaded on unicast channels.

73. The method of claim 69 wherein segments are downloaded on multicast channels.

74. The method of claim 69 wherein segments are downloaded on broadcast channels.

75. The method of claim 69 wherein a plurality of segments are downloaded concurrently at an aggregate rate, and wherein the aggregate rate is less than a maximum download rate.

1                    76.     The method of claim 69 wherein the media object is downloaded by a  
2     client at a rate less than an aggregate server transmission rate.

1                    77.     The method of claim 69 wherein the media object is downloaded by a  
2     client at an unconstrained rate.

1                    78.     The method of claim 69 wherein the media object is downloaded by a  
2     client at a rate only slightly greater than a media object play out rate.

1                    79.     The method of claim 69 wherein the media object is downloaded by a  
2     client at a rate less than a media object play out rate.

1                    80.     The method of claim 69 wherein joining and leaving a plurality of  
2     channels includes downloading at least a first segment upon the ending of the downloading of  
3     a second segment.

1                    81.     The method of claim 69 wherein a rate at which the media object is  
2     downloaded may be adjusted by joining and leaving channels.

1                    82.     The method of claim 81 wherein a client increases its reception rate by  
2     adding channels according to an order and decreases its reception rate by dropping channels  
3     either in a reverse of the order, or when a segment completes downloading on that channel.

1                    83.     The method of claim 81 wherein a client increases its reception rate  
2     when it experiences no congestion and decreases its reception rate when it experiences  
3     congestion.

1                    84.     The method of claim 69 wherein the blocks include original data, and  
2     wherein reassembling the blocks in each segment includes reordering the original data  
3     according to its temporal position in each block.

1                    85.     The method of claim 69 wherein reassembling the blocks in each  
2     segment includes decoding with a FEC decoder.

1                    86.     The method of claim 69 wherein reassembling the blocks in each  
2     segment includes decoding with a chain reaction decoder..

03763843.012700

1                    87.     The method of claim 69 wherein a single media object is downloaded  
2     from at least two servers.

1                    88.     The method of claim 87 wherein at least one segment is downloaded  
2     from at least two servers.

1                    89.     The method of claim 87 wherein at least one segment is downloaded  
2     from only one server.

1                    90.     The method of claim 69 wherein a same segment in the media object is  
2     downloaded from at least two servers.

1                    91.     The method of claim 69 further comprising playing out a pre-  
2     downloaded segment during the startup latency.

1                    92.     The method of claim 69 wherein the media object is downloaded by a  
2     client from a maximum number of channels concurrently.

1                    93.     The method of claim 69 wherein a set of channels on which at least  
2     one segment is downloaded varies over time.

1                    94.     A system for receiving a media object that includes segments of  
2     blocks, wherein each segment includes an integer number of blocks, and wherein each block  
3     is a unit of media for which a client will wait to receive an entire block before playing out the  
4     block, comprising:

5                    a module for handling input of a media object description of the media object;  
6                    a module for handling channel joins and channel leaves for each of a plurality  
7     of channels according to the media object description, wherein the channels are capable of  
8     use for downloading the segments to the client;

9                    a module for reassembling the blocks in each segment; and

10                  a module for playing the blocks out in an order after a startup latency.